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(54) ANIMAL FEED COMPOSITIONS

(71) We, SANKYO COMPANY LIMITED, a Japanese body corporate, of No. 1—6, 3-chome, Nihonbashi Hon-cho, Chuo-ku, Tokyo, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention is concerned with improvements in and relating to animal feed compositions. More particularly, the invention is concerned with animal feed compositions suitable to be fed to young domestic animals and which contain, as an essential ingredient, *Bacillus coagulans*.

Young domestic animals such as piglets, calves and the like are first fed after birth with mother's milk for 1—2 months and then gradually weaned onto an increasing amount of animal feeds which serve as substitutes for mother's milk. Good growth results may be attained by feeding such substitute feeds to domestic animals which are only 15 days old or even only a few days old because of the improvement in these feeds. Such early feeding of incomplete substitute feeds, however, results not only in the frequent occurrence of such disorders as diarrhoea and dyspepsia in the young domestic animals, thereby retarding the animals' growth, but also in a relatively high mortality rate of the animals.

Several proposals have been made to overcome the above drawbacks. Thus, it has been proposed that medicaments such as sulfa drugs, antibiotics and nitrofuran compounds should be fed to the young animals in admixture with conventional feed blends over a long period to prevent or inhibit the disorders mentioned above. However, sulfa drugs have the disadvantage that dyspepsia, which often leads to diarrhoea, occurs because of the drugs inhibiting the growth not only of harmful microorganisms but also of the useful microorganisms present in the animals in-

testines. Antibiotics and nitrofuran compounds suffer from the disadvantage that they do not completely prevent bacterial diarrhoea.

It is an object of this invention to provide an animal feed composition which may be satisfactorily employed for the feeding of young domestic animals as a substitute for mother's milk in the early stages of their life without leading to undesired disorders such as diarrhoea and dyspepsia.

According to the invention there is provided an animal feed composition which, in addition to one or more nutritional components, contains as an essential ingredient *Bacillus coagulans*.

The feed compositions of the present invention possess advantages in that they retain their initial *Bacillus coagulans* activities under storage over a long period of time; they do not cause any serious diarrhoea when given to young domestic animals; and they significantly enhance the growth of young domestic animals.

Bacillus coagulans as such is well-known and may be conveniently employed for the present purpose either as such or in the form of a so-called preparation. The term "preparation" as used herein means a storable preparation containing *Bacillus coagulans* and obtained by culturing *Bacillus coagulans* in a suitable medium and then treating the culture in such a manner that the resulting preparation predominantly contains *Bacillus coagulans*. For instance, a preferred preparation can be obtained by culturing *Bacillus coagulans* in a medium containing about 0.02% isoleucine and about 0.2% reducing sugar at a pH of from 4.5—8.4 under aerobic conditions at an oxygen partial pressure of from 35 to 250 mmHg, to bring about sporulation, separating the culture mass from the whole culture by conventional means, e.g. by means of a filter press or by means of a centrifuge, and drying the culture mass thus separated at a temperature of about 43 to 100°C. for

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not more than 12 hours and diluting the culture mass with a suitable excipient, e.g. starch or lactose.

In formulating the feed composition of the present invention, *Bacillus coagulans* either as such or in the form of a preparation is mixed with nutritional components employed in the basic feeding of young domestic animals, for example, base materials such as skim milk powder, alpha-starch and/or defatted soybean meal as a base stock and additives such as glucose, soybean oil, yeast and calcium carbonate. The amount of *Bacillus coagulans* as such or the preparation to be incorporated into the feed compositions of the present invention is preferably from about 0.05 to 3% by weight (calculated as *Bacillus coagulans* of a bacterium content of 10^8 per gram) of the total weight of the final composition. When a preparation is employed, there may be conveniently utilized a preparation which contains *Bacillus coagulans* in a bacterium content of 10^9 per gram, and it will, of course, be understood that the amount of the preparation to be employed will vary over a wide range, mainly based upon the bacterium content of the preparation utilized.

In order that the invention may be well understood, the following examples are given by way of illustration only.

EXAMPLE 1

A basic feedstuff is prepared having the following composition:

	<i>Ingredient</i>	<i>Amount (% by weight)</i>
35	Skim milk powder	25
	Alpha-starch	25
	Defatted soybean meal	20
	Fish meal	10
	Glucose	10
40	Soybean oil	4
	Yeast	3
	Calcium carbonate	0.4
	Calcium dihydrogenphosphate	1
	Sodium chloride	0.4

The above feedstuff is uniformly mixed with 0.1% by weight of a preparation containing *Bacillus coagulans* in a bacterium content of 10^9 per gram to give a feed composition according to the invention.

EXAMPLE 2

A basic feedstuff is prepared having the following composition.

<i>Ingredient</i>	<i>Amount (% by weight)</i>	
Alpha-starch	38	
Defatted soybean meal	35	55
Fish meal	8	
Glucose	10	
Soybean oil	3	
Yeast	2	
Calcium carbonate	0.5	60
Calcium dihydrogen phosphate	1.6	
Sodium chloride	0.4	

The above feedstuff is uniformly mixed with 0.05% by weight of a preparation containing *Bacillus coagulans* in a bacterium content of 10^9 per gram to give a feed composition according to the invention.

The following Examples will serve to demonstrate the effectiveness of the feed compositions of the present invention as compared with comparable feed compositions containing no *Bacillus coagulans*.

EXAMPLE 3

Ten 5-day old piglets of Middle-Yorkshire strain are divided into 2 groups of 5 each, these groups being hereinafter referred to as "Group A" and "Group B", respectively.

"Group A" is fed with the feed composition of Example 1 when the piglets are between 5-days old and 15-days old, with the composition of Example 1 and the feed composition of Example 2 (the amount of the latter being gradually increased over the feeding period) when the piglets are between 15-days old and 20-days old and then only with the feed composition of Example 2 when the piglets are between 20-days old and 35-days old.

"Group B" is similarly fed with the compositions of Examples 1 and 2 except that neither of the compositions contains *Bacillus coagulans* bacteria.

The average body weight, feed intake rate (as hereinafter defined) and severity of diarrhoea of Groups A and B are investigated.

The results are summarized below in Tables 1, 2 and 3.

TABLE I

Average body weight (kg.)

<i>Days-old Group</i>	0	5	15	20	35	<i>Body weight gain index</i>
A	1.20	1.42	3.72	4.53	8.95	115
B	1.23	1.48	3.60	4.16	8.10	100

TABLE 2

Feed intake rate*

Group	5—20 days old	Index	5—35 days old	Index
A	1.72	95.5	1.82	94.8
B	1.80	100	1.92	100

* The "feed intake rate" is the amount, expressed in kg., of the feed composition required to obtain 1 kg. of body weight gain or the value of the total feed intake divided by the total body weight gain.

TABLE 3

Severity of diarrhoea

A Group: No diarrhoea is observed during the period of investigation

B Group: Slight form of diarrhoea is observed in 3 piglets at about 17-days old, but soon disappears

EXAMPLE 4

5 Twelve 3-day old piglets of F_1 (first filial generation) between Landrace strain (male) and Middle Yorkshire strain (female) are divided into 2 groups of 6 each, these groups being referred to hereinafter as "Group A" and "Group B", respectively.

10 "Group A" is fed with the feed composition of Example 1 when the piglets are between 3-days old and 17-days old, with the composition of Example 1 and the feed composition of Example 2 (the amount of the

latter being gradually increased over the feeding period), when the piglets are between 17-days old and 24-days old, and then with the feed composition of Example 2 only when the piglets are between 24-days old and 38-days old.

15 "Group B" is fed in the same manner as described for Group A above but employing the feed compositions of Examples 1 and 2 not containing any *Bacillus coagulans*.

20 The results are summarized in the following tables.

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Average body weight (kg.)

Days-old Group	0	3	17	24	38	Body weight gain index
A	1.42	1.51	4.52	6.32	12.12	113
B	1.46	1.53	4.31	6.01	11.23	100

Feed intake rate

Group	3—17 days old	Index	3—38 days old	Index
A	1.52	90.5	1.79	90.0
B	1.68	100	1.00	100

Severity of diarrhoea

A Group: No diarrhoea is observed during the period of the investigation

B Group: Slight form of diarrhoea is observed on 4 piglets at between 5 and 15 days old and on piglets at between 16 and 20 days old, but soon disappears

From the foregoing results it will be apparent that the feed compositions of the present invention significantly stimulate the growth of young domestic animals without causing undesirable disorders such as diarrhoea and dyspepsia.

5 **WHAT WE CLAIM IS:—**

- 10 1. An animal feed composition which comprises at least one nutritional component and *Bacillus coagulans*.
- 15 2. An animal feed composition as claimed in claim 1 in which the *Bacillus coagulans* calculated as *Bacillus coagulans* material having a bacterium content of 10^8 per gram, is present in an amount of from 0.05 to 3% by weight.
- 15 3. An animal feed composition as claimed

in claim 1 or claim 2 which contains as nutritional components one or more of skim milk powder, alpha-starch or defatted soybean meal.

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4. An animal feed composition as claimed in any one of the preceding claims containing as an additional feed component one or more of fishmeal, glucose, soybean oil, calcium carbonate, yeast, calcium dihydrogen phosphate or sodium chloride.

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5. An animal feed composition as claimed in claim 1 substantially as hereinbefore described with reference to Example 1 or Example 2.

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